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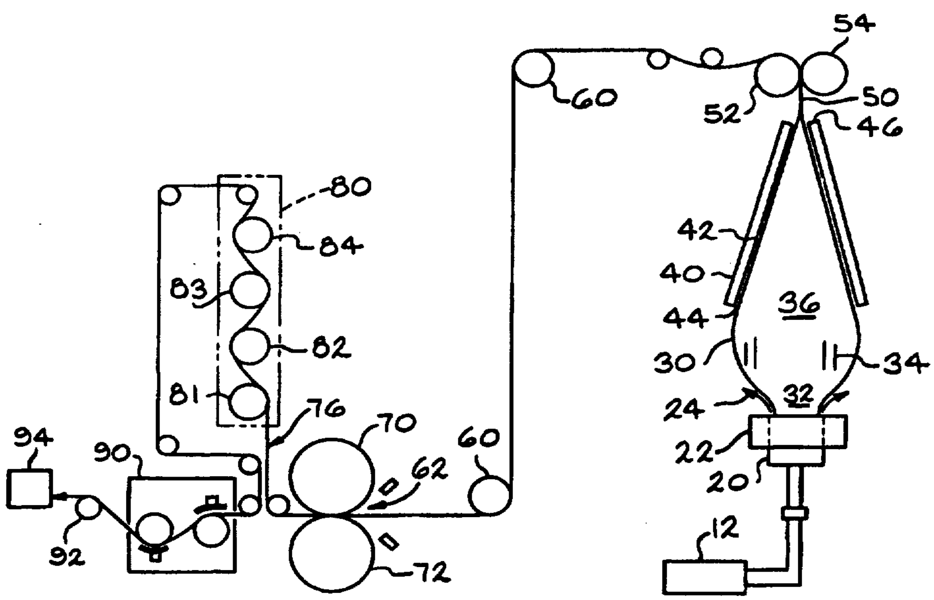

(57) Abstract

The present invention provides a compression roll oriented thermoplastic in-mold label which is produced by extrusion and compression rolled orientation of a film or sheet of thermoplastic material. The label is adhered to a thermoplastic container in a blowmolding process. In a preferred embodiment, the thermoplastic material of the label is substantially the same as the thermoplastic material of the blow molded container. In a preferred embodiment, the label comprises a single thickness of a high density polyethylene thermoplastic material.

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DESCRIPTION

COMPRESSION ROLL ORIENTED FILM FOR USE IN IN-MOLD LABEL APPLICATIONS

TECHNICAL FIELD

This invention relates to a film useful as a label. More particularly, the present invention relates to a compression roll oriented film for use in an in-mold label application.

BACKGROUND OF THE INVENTION

"In-mold" refers to both labeling methods and labels which are held in place within a blow-molding apparatus during the formation of a blow molded plastic container. Each container is formed in the mold with the label already in the mold. The use of an in-mold labeling process has advantages over conventional labeling of containers. The previous labeling methods included use of adhesive backed labels which are applied to the container. The label itself was a paper or polymeric material which had an adhesive layer applied to one side. The opposing side received the printing or ink material. A release liner was removeably affixed to the adhesive layer such that the label could be removed from the liner and placed on the container. The labeling of the container occurred after formation of the container itself. However, this additional step of applying a label onto the container added significant time and cost to the production of the container. Further, the label stock was typically printed in sheets and there was excessive or waste material in the areas adjacent the label itself. Still further, the adhesive-backed label complicated recycling efforts since the adhesive and the label were difficult to remove from the container. If the label remained affixed to the container during the recycling effort, the label and the adhesive were contaminants in the recycled plastic material.

In order to overcome these disadvantages, an in-mold labeling process was developed. A label was formed and cut to a desired configuration. A suitable amount of an adhesive material was applied to an inside surface of the label by the label forming manufacturer. Thereafter, the label was placed and held within a blow molding apparatus. A suitable amount of plastic material was injected into the molding apparatus. The plastic container was formed in the mold while the label was held in position in the mold.

In the past, the kinds of in-mold labels included paper labels and certain types of multilayer polymeric film labels. The polymeric film labels comprised coextruded multiple layer film structures and/or additives which were needed so that the film could compatibly receive the printing inks and adhesives. One disadvantage with using the multi-layer polymeric in-mold labels is that the multi-layer polymeric film being used to form label itself must be able to withstand various stresses when being converted from film into a label. The multi-layer polymeric film is printed, dried and cut into a label and thereafter put into position within the molding apparatus. In the past, the various types of multi-layer polymeric labels required a layer of a suitable amount of adhesive material on one side of the label to allow the label to remain adhered to the blow molded plastic container.

It is important that the film comprising the in-mold label have suitable mechanical properties such that the label, when used in a high speed blow-molding operation, can be rapidly positioned within the mold apparatus in a uniform manner. The in-mold label is thus required to have a balance of competing properties. The film used to form the label must have suitable strength to withstand the printing and cutting processes. The label must also be sufficiently stiff or rigid in order to be inserted into the blow-molding apparatus without any distortion, wrinkling or folding of the label and yet must also possess suitable

flexibility to remain adhered to the plastic container during use of the container.

In past in-mold labeling processes after the label has been formed, a layer of an adhesive material is incorporated into or applied by the film manufacturer. This presents another disadvantage since the label end-user cannot vary the amount or thickness of the adhesive material on the film. This presents another disadvantage since, once the adhesive material is applied to or incorporated into the label, the label cannot be reverse printed that the ink is between the bottle and the label. No ink can be directly applied to the adhesive backed label since the ink is incompatible with the adhesive material and the ink would run or be distorted.

One example of a multi-layer in-mold label is found in U.S. Patent No. 5,242,650 to Rackovan et al. which comprises a multi-layer coextruded, hot stretched, and annealed in-mold label. The multilayer label has a top or face layer, an adhesive-containing base layer, and a central or core layer. Each layer of the multi-layer label comprises various ingredients and additives which are different from the composition of the blow molded container. The multilayer label adds both additional expenses and contaminants to the container which makes the blow molded container difficult to recycle. The Rackovan et al. '650 label is thick multiple layer label which is needed in order to provide the label with sufficient stiffness to avoid wrinkling and folding during the handling and insertion of the label into the blow molding apparatus. However, a major disadvantage to the thick multi-layer label is that much more label material is needed to make the label which increases the costs of the labels and which increases the time and difficulty in manufacturing the label.

Another example of an in-mold label is the Rackovan et al. U.S. Patent No. 5,435,963, wherein a multilayer label film is coextruded, hot

stretched, and annealed, or wherein non-adhesive laminae or layers of the film are separately formed and combined with an adhesive containing layer or laminae either before or after hot stretching and annealing. However, the Rackovan et al. '963 label has the same problems as the '650 label since the compositions of the multilayer labels contain multiple ingredients and additives which greatly complicate any recycling process. Further, the label itself (since it has multiple ingredients and additives) is incompatible with the composition of the blow molded plastic container. This incompatibility of the label with the container itself requires the use of an adhesive material to securely adhere the label to the container.

DESCRIPTION OF THE INVENTION

The present invention provides a unique film for making a label for use in in-mold labeling processes. The label of the present invention solves the problems of label distortion in high speed printing presses, wrinkling and/or folding during insertion of the label in the mold, and unwanted static charges without adversely affecting the printability and cuttability of the label itself. The label of the present invention is provided by using a unique process for producing a compression rolled oriented film. The present invention provides in-mold labels with desirable levels of dimensional stability, sufficient stiffness, tensile strength, and resistance to shrinkage. In a preferred embodiment, the in-mold label film is formed by extruding a polymeric film material such as high density polyethylene, polyethylene terephthalate or other suitable material to form a film. The extruded film material is formed by compression roll orientation. The extruded film can be formed using, for example, a blown, casting or sheet extrusion casting process. In certain preferred embodiments, films produced for in-mold labeling applications are produced by a blown extrusion manufacturing method.

According to a preferred embodiment the present invention, a single thickness of a thermoplastic film is oriented and compressed by passing the film through a nip formed by at least one pair of milling rolls. The film has improved mechanical properties due to the compression roll orientation, including, for example, good stiffness, flexibility, and clarity. The film can also be used to make labels having a thinner gauge that was previously possible with the earlier in-mold labels. The thinner gauge labels provides both manufacturing and cost benefits.

The present invention eliminates the need, in many embodiments, for an adhesive layer on the label. The elimination of any adhesive layer on the label itself allows the end user to control whether any adhesive is needed. Further, in certain embodiments, the label can be reverse printed. In other embodiments where an adhesive material is desired to be applied to the label, it is now possible to allow the end user to choose what kind and how much of any adhesive material is to be applied to the label. The label of the present invention is especially useful where the end user desires to apply the adhesive at a particular depth, in a certain pattern, or to use different adhesive materials, such as water-based or solvent-based materials. The label of the present invention provide greater versatility to the blow molding manufacturer. By using the label of the present invention, the blow molding manufacturer can reduce the amounts and the kinds of different label materials in inventory.

The present invention now allows the manufacturer to apply a label to the container which label is substantially the same material as the container itself. The label of the present invention greatly aids recycling efforts since the label can be readily recycled along with the container without adding to the contaminants in the recycled plastic material.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a simplified schematic plan view of an extruded, compression rolled orientation method using a blown film process.

Fig. 2 is a simplified schematic plan view of an extruded, compression rolled orientation method using a film casting process.

Fig. 3 is a simplified schematic plan view of an extruded, compression rolled orientation method using a sheet extrusion casting process.

Fig. 4 is a schematic diagram of a container having an in-mold label.

Fig. 4A is a cross-sectional enlargement of the portion 4A shown in Fig. 4.

Fig. 4B is an exploded, cross-sectional view taken along the line 4B-4B in Fig. 4A.

BEST MODE OF CARRYING OUT INVENTION

It is now possible to make an in-mold label having equivalent or superior properties as compared to conventionally produced in-mold labels by using an extruded compression rolled orientation method of forming a film. The compression rolled orientation process is useful for providing thinner gauge films with improved properties over other in-mold labels.

The present invention provides also an in-mold label with the desirable mechanical properties of: clarity, stiffness, elongation, tensile modulus, and tensile strength. The low elongation at break and the high modulus properties of the film provide the in-mold label with the desired good dimensional stability needed for the printing and converting of the film into a label.

The present invention also has a desirable high gloss and a high contact clarity which allows for reverse printing of the label. Reverse

printing is an especially desirable property for many end use applications for in-mold labels. For example, reverse-printed labels are especially useful on containers whose contents, if spilled, could adversely impact the ink on the label by dissolving or destroying the ink or other such undesirable occurrences.

It is also within the contemplated scope of the present invention that any further processing can be readily accomplished using the label of the present invention. For example, in certain embodiments, it may be desired by the end user to apply an anti-static varnish type material to the label to effectively eliminate any static discharges which might occur. In such a process, the print ink is applied first to one side of a label and then the adhesive is applied to the ink. The antistatic material is applied to the opposite side of the label as the print and adhesive. The antistatic material thus does not adversely effect the printing.

One advantage of the present invention is that the film used to make the labels can be produced using a variety of polymeric materials. In preferred embodiments, the polymeric material is the same or similar to the material comprising the container itself. A container having a label which is made of substantially the same polymeric material provides many advantages to both the blow molding manufacturer and the consumer. In particular, one advantage is that during the blow mold manufacturing process any defective bottles can be immediately recycled. The defective bottles can be reground and added back into the supply of polymeric material for making the blow molded container. It is to be understood that it is within the scope of the present invention that the materials comprising the labels can be blended in accordance with the Society of the Plastics Industry voluntary recycling standards and code system for labeling all plastic containers with a code to identify the primary resin in the container.

Thus, another advantage is that the blow-molded container having a label of the present invention thereon, when recycled, will allow the recycler to have a much purer recycled resin content which is especially useful in resale markets. The recycler thus has a greater confidence that the code on the bottom of the container accurately reflects the actual identity of the resin comprising the container itself.

In preferred embodiments, the present invention provides a film which comprised a polymeric material such as high density polyethylene (HDPE), medium density polyethylene (MDPE), low density polyethylene (LDPE), linear polyethylenes such as butene, hexene and octene copolymers, polypropylene (PP), nylon, ethylene vinyl alcohol (EVOH), polyesters, polyacrylonitrile, polyvinylidene chloride (PvDC), polyethylene terephthalate (PETE), and blends of the above.

One preferred method for making a label of the present invention comprising a high density polyethylene (HDPE) material is shown in Fig. 1. It is to be understood that other materials can be used with the present invention and that the following description is merely illustrative.

It is to be understood that various other ingredients, opacity modifiers, and slip agents or coefficient of friction reducing agents are useful in the film of the present invention and are within the contemplated scope of the present invention.

The present invention provides film thicknesses ranging from about 0.30 mil to about 8.0 mil. The preferred film ranges from about 2.0 mil to about 3.5 mil and most preferably from about 2.5 to about 3.0 mil. It is to be understood that in embodiments where the film is formed by a blown film method, the identical amount is contained in each web of the film, as will be understood readily by the following explanation.

Referring now to Fig. 1, the polymeric material which is to ultimately form the film is extruded from an extruder 12. The extruded material passes from the extruder 12 and passes through a die 20. An

air ring 22 forces cold air in the direction of the arrows 24 such that a blown film bubble 30 is formed. The temperature of the film is greater than the melting point of the extruded material at point 32, such that the film is molten. As the film cools, a frost line 34 occurs generally as shown with vertical lines. The film is quenched or cooled such that the temperature of the film drops and at point 36 the film is generally below the temperature of the recrystallization (Tc).

The frost line area 34 is determined by the amount of coolant air on the bubble 30, as well as melt temperatures exiting the die and polymer flow rate (pounds per hr.). The higher the frost line 34 or farther away from the air ring 22, the more crystalinity is imparted to the film. Also, when the frost line 34 is higher, the temperature drop of the molten material is slower and the film spends more time at the maximum crystallization rate temperature (Tc) which also provides a higher density to the film. Higher density films yield better mechanical properties in the final oriented film product. The lower the frost line 34, or closer to the air ring 22, the better thickness control for the film is possible.

Continuous portions of the bubble 30 pass by air flatteners 40. The air flatteners 40 contain a plurality of apertures 42 which allow air to flow from the air flattener 40 in the direction of the bubble 30. The air flatteners 40 provide internal pressure which is forced out through the apertures 42 to provide an air cushion 44 so that the bubble 30 slides on air. A cushion of air 44 is provided by the air flowing through the apertures 42 such that the bubble 30 does not adhere to the air flatteners 40 or become wrinkled as the bubble 30 is being collapsed. The bubble 30 collapses at a point adjacent to the trailing edges 46 of the air flatteners 40 and collapses to form a web material 50. The film material 50 passes through squeeze rolls 52 and 54. In preferred embodiments, the squeeze roll 52 comprises a steel material, while the squeeze roll 54 comprises a rubber material on its surface.

The film 50 passes over at least one roll 60 and through a nip 62 formed by a pair of compression milling rolls 70 and 72. The compression milling rolls 70 and 72 compress and orient the film 50 to form a compression roll oriented film 76. The compression roll oriented film 76 passes through a post-annealing mechanism 80 comprising a plurality of post-annealing rolls 81, 82, 83 and 84. It is to be understood that the number of post-annealing rolls can be varied. Thereafter, in certain embodiments, the film 76 can pass through a corona treatment mechanism 90, over a chill roll 92, and to a winding section 94. The chill roll 92 removes latent heat in the film 76. When the latent heat is not removed, the film 76 can experience stress relief or shrinkage after winding, which can crush a core (not shown) on which the film is wrapped.

The post-annealing of the film provides stress relief and dimensional stability to the film at elevated temperatures. The dimensional stability reflects the film's ability to shrink at elevated temperatures. In preferred embodiments, it is desired to have the temperature on the surfaces of the rolls 81-84 be a slightly lower temperature than the temperatures used in conventional post-annealing methods. Further, in various embodiments, it has been found to be desirable to use annealing rolls which have a relatively larger diameter than rolls used in prior art processes. The larger diameter annealing rolls allow the time and temperature at which the film is being annealed to be manipulated which, in turn, increases the dimensional stability and provides the film with better stress relief.

It is to be understood that other extrusion methods can be utilized to provide a compression roll oriented film for use as an in-mold label. The film may be produced by casting a film using slot-die film casting technology and compression rolled orienting the resulting film. Fig. 2 shows a film casting which involves extruding molten polymer through

a flat die 100. In preferred embodiments the die 100 has a die gap of about 0.01-0.06 inches. The extruded material is drawn down to a gauge suitable to form a thin film 102 from the extrusion die 100 using a large metal casting roll 104. The metal roll 104 may enter a water bath (not shown) to quench the film. The film 102 may be pinned or held against the casting roll 104 by a suitable holding device 106 such as an air knife, vacuum box, electrostatic charge or rubber nip roll. In embodiments where a rubber nip roll is utilized (not shown), it is desired to have a highly polished smooth surface on the rubber nip roll. It has been found in preferred embodiments that the optimum mechanical properties are obtained by utilizing relatively low melt temperatures, high casting roll temperatures and no water bath. In preferred embodiments, a stripper roll 108 is utilized to maximize the film contact time on the casting roll 104. The film 102 passes through a nip 110 formed by at least one pair of compression milling rolls 112 and 114. The rolls 112 and 114 compress and orient the film 102 to form a compression roll oriented film 120 which is then passed through a post annealing mechanism 130 comprising a plurality of post-annealing rolls 131, 132, 133, and 134. It is to be understood that the number of post-annealing rolls can be varied. Thereafter, in certain embodiments, the film 120 can pass through a corona treatment, over a chill roll, and to a winding section, as described above.

Another casting process which can be utilized to form a sheet comprises sheet extrusion technology. This method is especially useful for producing thick films with higher crystalinity and excellent smooth or high polished surfaces. One example of a sheet extrusion method is generally shown in Fig. 3, wherein a die 200 extrudes a sheet 202 material over a plurality of temperature controlled polish rolls 204. It is contemplated that various types of extrusion cast die systems are useful, in the present invention including systems where the viscosity and flow

rate of the polymers can be adjusted. In preferred embodiments, there is a controlled gap of about between 75 to about 90% of the nominal sheet thickness, such that the sheet 202 passes between the temperature controlled polish rolls 204 and over cooling roll 206 adjacent the polished rolls 204. The sheet 202 produced according to this method preferably can have thicknesses ranging from 0.006 to about 0.50". The sheet 202 passes around a stripper roll 208 which is utilized to maximize the sheet contact time on the cooling roll 206. The sheet 202 passes through a nip 210 formed by compression milling rolls 212 and 214. The compression milling rolls 212 and 214 compress and orient the film 210 to form a compression roll oriented film 220. The compression roll oriented film 220 passes through a post-annealing mechanism 230 comprising a plurality of post-annealing rolls 231, 232, 233, and 234. It is to be understood that the number of post-annealing rolls can be varied. Thereafter, in certain embodiments, the film 220 can pass through a corona treatment mechanism, over a chill roll, and to a winding section, as described above.

The compression roll oriented film can be formed into a label in a suitable manner by being printed using a suitable printing and drying method. The film can then be formed into sheets or individual labels and stacked in a suitable manner for being supplied to an in-mold labeling apparatus. The labels are supplied in a suitable manner to a blow-molding apparatus. The label of the present invention has a sufficient thickness to be quickly and accurately placed within the mold. The label is held accurately in position within the mold by a suitable means such as vacuum or other means. A suitable amount of thermoplastic resin is injected into the mold and is blown into the desired container shape in a known manner. As the molten thermoplastic resin comes into contact with the label of the present invention, the label readily adheres to the blown container. It is to be understood that the rapid cooling of the

molten thermoplastic resin does not melt the label. The temperature of crystallinity (Tc) of the label is greater than the temperature of the rapidly cooling thermoplastic resin being injected into the mold. The label is adhered to the container in an integral manner without any warping or distorting of either the label or the container during the blow-molding process.

It is to be understood the label of the present invention is useful both with and without any adhesive layer in order to adhere the compression roll oriented label to the blown container. The label of the present invention provides an advantage to the end user to determine the type and amount of any adhesive, if needed, for specific end use applications. The lack of an adhesive on the label also allows the label to be reverse printed by directly applying the ink to an inside surface of the label. The ability to reverse print a label provides superior protection to the print ink on the label, as compared with surface printed labels.

It is further to be understood that the compression roll oriented label is useful both with and without any anti-static material. The lack of any anti-static material incorporated into the polymeric composition of the label itself allows the end user with the option whether to use any anti-static material. For example, in certain end use applications, the static discharge may be effectively eliminated by applying a clear anti-static varnish to and outside surface of the label. The anti-static varnish material can be applied to outside surface of the label such that the surface varnish does not adversely affect the print ink.

Referring now to Figs. 4, 4A and 4B, a bottle 300 having a label 302 of the present invention applied thereto is shown. Fig. 4 is a perspective view of the bottle 300 having the label 302 applied to an outside surface 303 of the bottle 300. Fig 4A is a cross-sectional, schematic enlargement, taken along the line 4A-4A in Fig. 4 and is not intended to show the differences in the actual thicknesses of the bottle

and the label. In preferred embodiments, the bottle 300 is made of a suitable thermoplastic material which is compatible with the thermoplastic material of the label 302.

The Fig. 4B is an exploded, cross-sectional schematic view taken along the line 4B-4B in Fig. 4A. It is to be understood that the schematic illustration of the label 302 applied to the bottle 300, as shown in Figs. 4A and 4B have been greatly exaggerated in order to fully show the details of the present invention. The bottle 300 has an inside surface 304 which is opposed to the outside surface 303 of the bottle 300. The label 302 has an outer surface 310 and an inner surface 312. A suitable amount of ink artwork 320 is applied to the inner surface 312 of the label 302. The ink artwork 320 has an outer surface 322, which is in contact with and adheres to the inner surface 312 of the label 302, and an opposing inner surface 324. The ink artwork 320 can be continuous or discontinuous on the inner surface 312 of the label 302, as shown in Fig. 4B, such that there is at least one opening or gap 326 between portions of the ink artwork 320.

In certain embodiments, a suitable amount of an adhesive material 330 can be applied to the inner surface 324 of the ink artwork 320, where the ink artwork is present. Also, a suitable amount of the adhesive material 330 can be directly applied to the inner surface 312 of the label 302 through the opening 326. It is to be understood that the adhesive material 330 can be applied to the label 302 in any suitable manner, such as in a certain pattern, amount, and thickness. It is also within the contemplated scope of the present invention that the label 302 can be applied to the bottle 300 without the use of any adhesive material. In certain embodiments, it is desired to have a suitable anti-static type material 340 on the outer surface 310 of the label 302. It is to be understood that Fig. 4B shows an embodiment with both an adhesive material and an anti-static material present for the sake of a

complete explanation of the embodiments of the present invention, but that either or both the adhesive and antistatic material showing labels can be dispensed with, depending upon the end user's requirements.

Table I below provides examples 1 and 2 showing labels of the present invention, which comprise a single layer, high density polyethylene compression roll oriented label as compared to conventional multilayer, in-mold label comparative examples.

Comparative example 1 comprises a three-layer label composition having, by weight percentages, the top layer comprising polypropylene homopolymer 50%, ethylene/vinyl acetate copolymer 50%; the middle layer comprising random polypropylene copolymer 60%, ethylene vinyl acetate copolymer 40%; and the base layer comprising heat activatable adhesive 25%, polypropylene homopolymer 25%, ethylene vinyl acetate copolymer 45%, anti-static material 5%.

Comparative example 2 comprises three-layer label composition having the top layer comprising polypropylene homopolymer 50%, ethylene vinyl acetate copolymer 50%; the middle layer comprising polypropylene homopolymer 85%; ethylene vinyl acetate copolymer 15%; and, the base layer comprising heat activatable adhesive 25%, polypropylene homopolymer 25%, ethylene vinyl acetate copolymer 45%, anti-static material 5%.

Comparative example 3 comprises a three layer composition having the top layer comprising polypropylene homopolymer 50%, ethylene vinyl acetate copolymer 50%; the middle layer comprising polypropylene homopolymer 70%, ethylene vinyl acetate copolymer 15%, titanium dioxide concentrate 15%; and, the base layer comprising ethylene vinyl acetate copolymer 50%, low density polyethylene 50%.

Comparative example 4 comprises a three-layer label composition having the top layer comprising polypropylene homopolymer 50%, ethylene vinyl acetate copolymer 50%; the middle layer comprising

random polypropylene copolymer 80%, ethylene vinyl acetate copolymer 20%; and, the base layer comprising ethylene vinyl acetate copolymer 50%, low density polyethylene 50%.

The Gurley stiffness is measured in milligrams using the test method designated as TAPPI T543PM. The tensile modulus and ultimate tensile strength were measured using the ASTM test procedure D882. The percent of haze was measured using the ASTM procedure No. D-1003 on a Gardener apparatus. The percent of gloss was measured using the ASTM procedure No. D-2457 on a Gardener apparatus.

As seen in Table I, the labels of the present invention achieve acceptable stiffness, elongation, tensile modulus, and tensile strength properties at a much lower thicknesses than the comparative examples. The low elongation at break property and the high modulus property of the label of the present invention provide good dimensional stability to the label so the film can be readily printed and converted into an in-mold label.

The label of the present invention has a high gloss appearance and high contact clarity which allows for reverse printing. The printed ink can be applied on the inner face of the label, such that when the label is applied to a container, the ink is between the container and the label.

In preferred embodiments, the percent of haze is preferably less than about 20. It is to be noted that in prior art labels the percent of haze is much greater, typically in the range of about 65 to 70 percent.

TABLE I

	Recommended Values	Example #1	Example #2	Compar. Ex. 1	Compar. Ex. 2	Compar. Ex. 3	Compar. Ex. 4
Thickness (mils)	None Given	2.9	2.6	4.0	4.0	4.0	4.0
Gurley Stiff (mg)							
MD	40-130	50	38.5	45	80	80	65
TD	20-65	48	46.6	20	35	35	30
Elongation (%)							
MD	<950	14	50	55	45	45	44
TD	<950	7	13	800	500	275	925
Tensile Modulus (1000 psi)							
MD	>65	282	324	145	270	285	220
TD	>65	325	297	45	90	100	75
Tensile Str. (1000 psi)							
MD	None Given	24.4	31.1	18.0	27.0	25.0	23.0
TD	None Given	6.2	5.8	2.2	3.3	2.5	3.5
Haze (%)		16	10				
Gloss (45°)		70	68				

The present invention provides a compression roll oriented label which has both the desired stiffness and tensile strength for use in an in-mold label application. It is important to note that the compression roll oriented label of the present invention can be produced at a much thinner gauges than the comparative examples. This provides an advantage to the package designer who can utilize a label having a thickness from about 2.0 to about 3.5 mils. The package designer is provided with a significant difference in label thickness which translates into great savings when the package designer must produce millions of packages and labels. It is to be noted that the savings of about a mil or more difference becomes significant to the end user, especially when the label performance criteria are still being achieved.

The present invention has been described in detail by reference to a preferred embodiment. However, it is apparent that modifications and variations are possible without parting from the scope of the invention defined in the appended claims. Several changes or modifications have been briefly mentioned for the purposes of illustration.

WE CLAIM:

1. An in-mold label comprising a thermoplastic polymeric material, the label being produced by compression rolled orientation, and having a machine direction Gurley stiffness value greater than about 40.

2. The label of claim 1, wherein the label thickness ranges from about 0.30 mil to about 8.0 mil.

3. The label of claim 2, wherein the label thickness ranges from about 2.0 to about 3.5 mil.

4. The label of claim 1, wherein the label has a haze less than about 20.

5. The label of claim 1, wherein the thermoplastic material comprises high density polyethylene, medium density polyethylene, low density polyethylene, linear polyethylenes including butene, hexene and octene copolymers, polypropylene, nylon, ethylene vinyl alcohol, polyester, polyacrylonitrile, polyvinylidene chloride, polyethylene terephthalate and blends thereof.

6. The label of claim 5, wherein the thermoplastic material comprises high density polyethylene.

7. The label of claim 5, wherein polymeric material includes a material in an amount sufficient to control the opacity or color of the label.

8. A process for making an in-mold label comprising:

supplying a film or sheet comprising a polymeric material; and

passing the polymeric film or sheet through a nip to compress and orient the film or sheet to form the in-mold label.

9. The process of claim 8, wherein the polymeric film or sheet is supplied by extruding the polymeric material from a die and drawing the extruded polymeric material down to a predetermined gauge.

10. The process of claim 8, wherein the polymeric film or sheet is supplied by extruding a layer of the polymeric film material; blowing the extruded layer into a bubble to stretch and cool the polymeric material; and, collapsing the bubble to form the film or sheet prior to subjecting the film to compression rolled orientation.

11. The process of claim 8, further comprising subjecting the compression rolled oriented film or sheet to a post-annealing process and, optionally, a corona treatment process, to form the in-mold label.

12. The process of claim 8, further including printing a first side of the film or sheet with a suitable ink material and subsequently drying the ink; and,

cutting the film or sheet to form individual labels.

13. The process of claim 12, further including supplying a suitable amount of an adhesive material to the printed first side of the label.

14. A process for adhering a compression roll oriented thermoplastic label to a blow molded container comprising:

placing the compression roll oriented thermoplastic label in a blow molding apparatus; and,

injecting a suitable thermoplastic material into the blow molding apparatus to form the blow molded container whereby the label adheres to the container.

15. The process of claim 14, wherein the label and the blow molded container are comprised of substantially the same thermoplastic material.

16. The process of claim 14, wherein the thermoplastic material comprises high density polyethylene, medium density polyethylene, low density polyethylene, linear polyethylenes including butene, hexene and octene copolymers, polypropylene, nylon, ethylene vinyl alcohol, polyester, polyacrylonitrile, polyvinylidene chloride, polyethylene terephthalate and blends thereof.

17. The process of claim of 16, wherein the thermoplastic material comprises high density polyethylene.

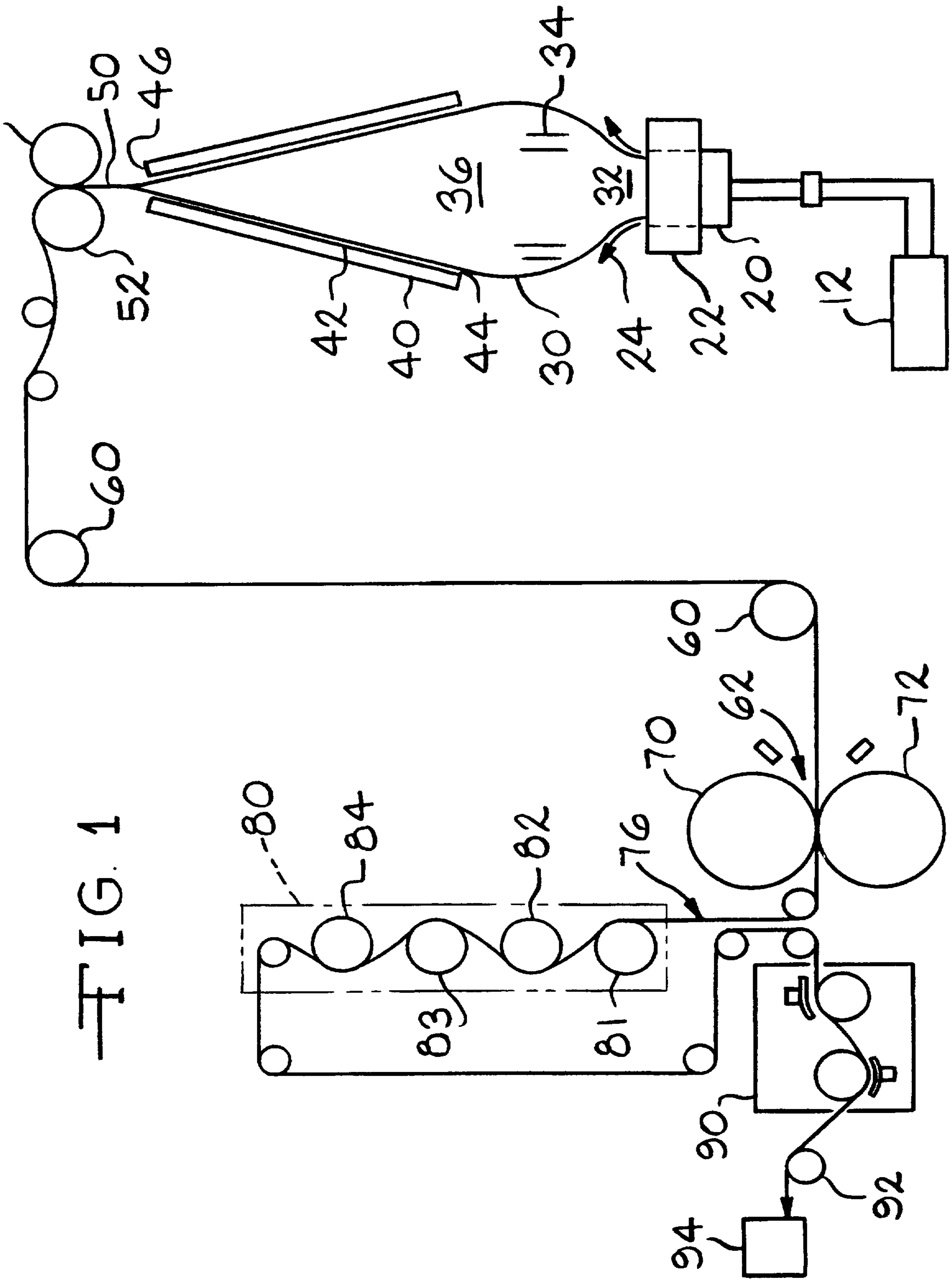
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FIG. 1

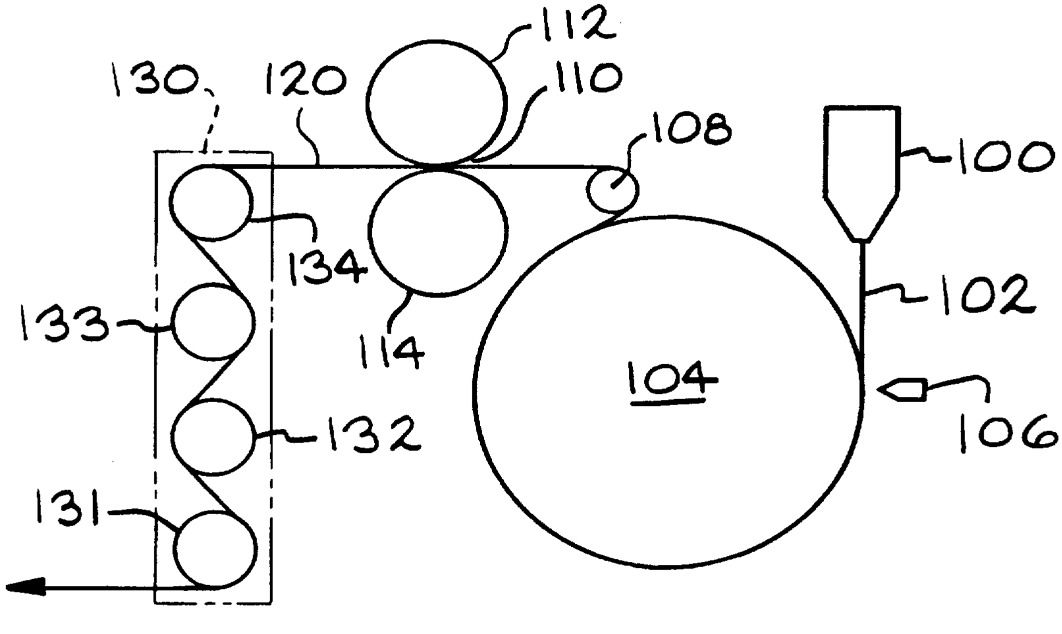
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FIG. 2

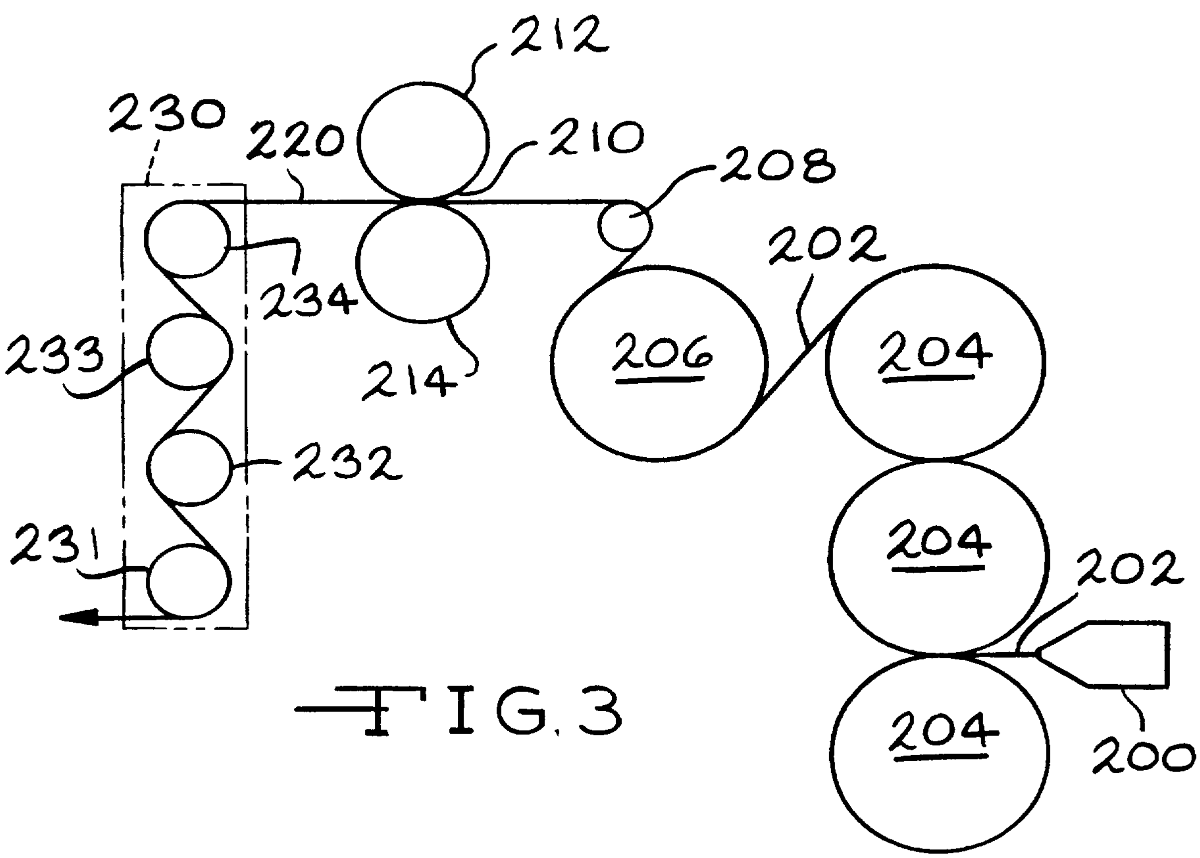
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FIG. 3

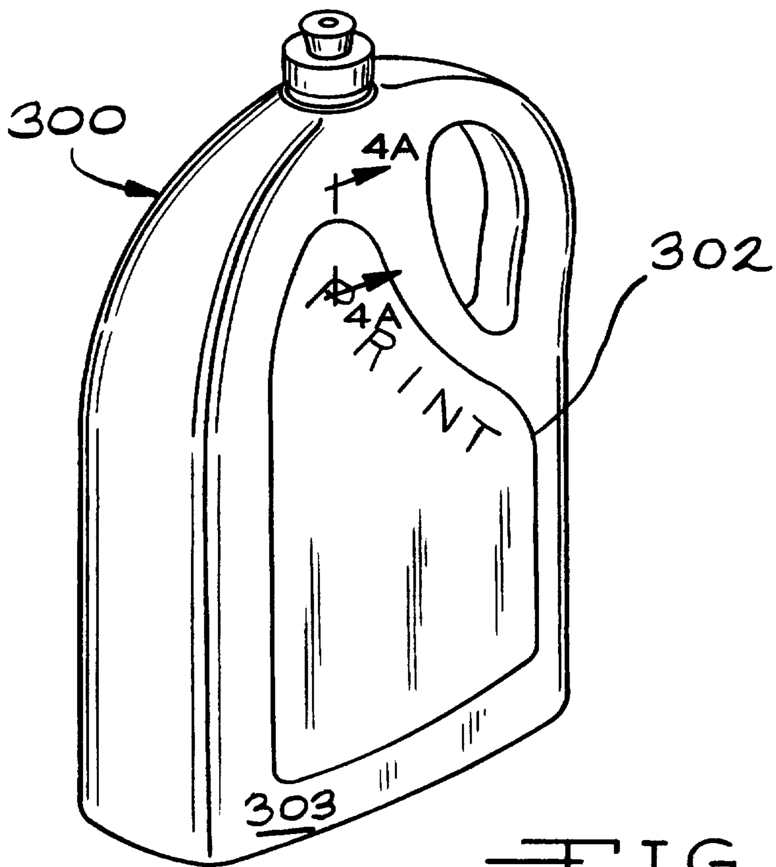


FIG. 4

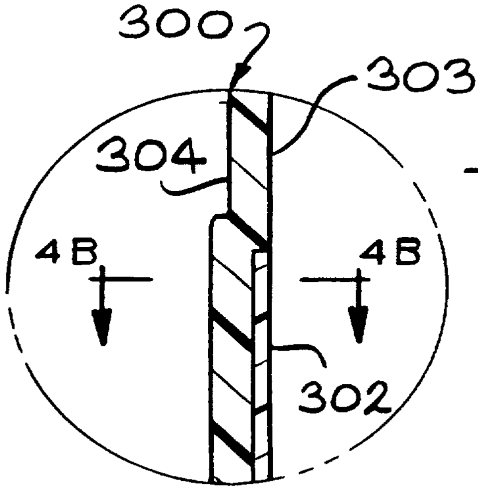
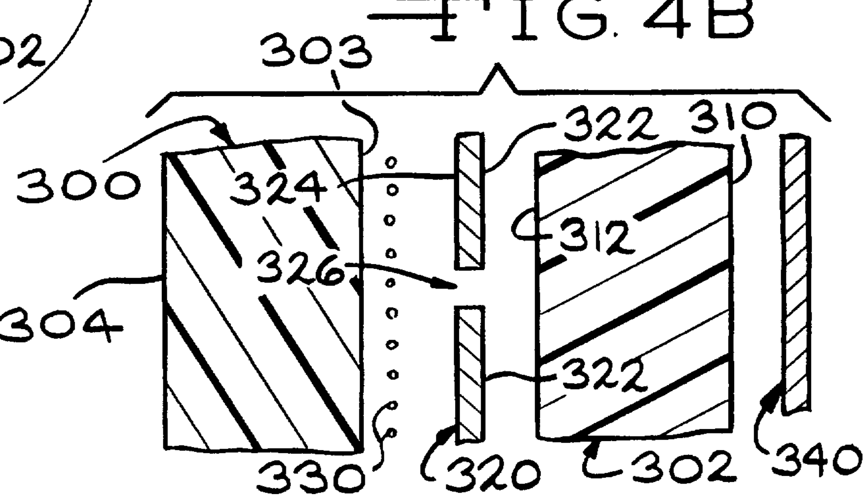


FIG. 4A

FIG. 4B



INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 97/12442

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B29C49/24 B29C55/18 G09F3/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B29C G09F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 516 393 A (FREEDMAN MELVIN S) 14 May 1996 see column 4, line 9 - line 14 see column 7, line 57 - line 61 see column 8, line 46 - line 57 see column 9, line 26 - column 10, line 16 ---	1-17
Y	US 5 451 283 A (JOSEPHY KARL ET AL) 19 September 1995 see column 2, line 4 - line 19 see column 7, line 42 - line 61; table 1 ---	1-17
A	EP 0 502 396 A (OJI YUKA GOSEISHI KK) 9 September 1992 see page 6, line 1 - line 3 --- -/--	11,12

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
8 October 1997	21.10.97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Attalla, G

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 5 039 298 A (TAKAKUSAKI NOBUYUKI ET AL) 13 August 1991 see column 10, line 39 - line 42 ---	15
A	US 5 435 963 A (RACKOVAN MITCHELL J ET AL) 25 July 1995 cited in the application see column 6, line 24 - line 52 -----	1-17

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